Monitoring and projection of targets for risk and protection factors for coping with noncommunicable diseases in Brazilian capitals

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Abstract *This study aimed to monitor the trends and projections of targets of risk and protection factors for coping with noncommunicable diseases in Brazilian capitals and verify whether the economic crisis and austerity policies have interfered with these targets' behavior. This is a time-series study with data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey. We analyzed the trends in the prevalence of tobacco use, obesity, physical activity, consumption of fruits and vegetables, and alcohol abuse, and their projections until 2025. The Prais-Winsten regression was employed. We adopted the Interrupted Time-Series, considering the 2006-2014 and 2015-2019 periods. A reduction in tobacco use, increase in obesity, consumption of fruits and vegetables, physical activity, and alcohol use was observed between 2006 and 2014. Most indicators have shown worse performance since 2015. Projections foresee that targets for curbing obesity and alcohol abuse will not be achieved. Some changes were identified in the indicators profiles, reinforcing the importance of the continuous monitoring and sustainability of actions, policies, and programs to promote health and control these diseases and their risk factors.*

Key words *Noncommunicable diseases, Risk factors, Protective factors, Interrupted time-series analysis, Economic recession*

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Introduction

Chronic noncommunicable diseases (NCD) are the leading causes of global death and cause premature mortality, disability, loss of quality of life, reduced productivity, and financial impacts on families, communities, and society[1].

Annually, NCDs are responsible for an estimated 71% of global mortality, totaling 41 million deaths[2]. Of these, 15 million are premature (< 70 years), and about 12 million occur in low- and middle-income countries[2]. In the Americas, NCDs cause 5.5 million annual deaths, equivalent to 80.7% of all deaths, and 38.9% of these are premature[3]. The situation is similar in Brazil, corresponding to 74% of overall mortality[3].

The higher burden of NCDs is related to higher modifiable risk factors (RF)[4], such as tobacco and alcohol use, obesity, physical inactivity, and inadequate diet[1]. Also, we highlight the importance of social determinants, especially low socioeconomic status, as strong predictor of causality, morbidity, and premature mortality due to NCDs, and the effects of economic crises and austerity policies affecting social policies, quality of services, indicators, and health system, escalating unemployment, poverty, and inequalities[5-7].

NCDs are preventable, and strategies include promoting health, adopting healthy lifestyles, and encouraging protective factors, such as healthy eating and physical activity. In this sense, the Ministry of Health launched in 2011 the 2011-2022 Strategic Action Plan for Coping with NCDs in Brazil to promote the development and implementation of effective, integrated, sustainable, and evidence-based public policies for the prevention and control of NCDs and their RFs[1,8].

Globally, in 2013, the World Health Organization (WHO) approved the Action Plan for the Prevention and Control of NCDs, which included policy options that contribute to the progress of global goals to be achieved by 2025[9] when collectively implemented, a crucial multilateral agenda to address NCDs. Thus, the national plan's goals coincide with the global goals and are significant progress to face NCDs and their RF[10].

Brazil has a structured NCDs surveillance system to monitor the goals proposed and assumed globally. It has been implemented in different surveys, such as the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (Vigitel), the National Health Survey (PNS), and the National Student Health Survey (PeNSE), which allow monitoring the achievement of goals by analyzing historical series[11]. The goals should be continuously monitored by the country, civil society, and health, education, and research institutions, as they contribute to the reorientation of health services, primary care, and the work process while assisting in the review of strategies for the prevention, coping, and control of NCDs, especially in a setting of economic crisis and austerity that can compromise health outcomes and indicators.

In this sense, this study aims to monitor the trends and projections of the goals of risk and protection factors for coping with NCDs in Brazilian capitals and verify whether the economic crisis and austerity policies interfered in these goals' behavior.

Methods

This is a time-series study of the prevalence of risk and protection factors for NCDs. We employed 2006-2019 Vigitel data. Vigitel is a population-based telephone survey that annually monitors the frequency and distribution of NCDs' main RFs. The sampling procedures employed aim to obtain the representativeness of the capitals of the 26 Brazilian states and the Federal District through probabilistic samples from the population of adults (≥18 years of age) living in households with at least one landline. Approximately 2,000 interviews are conducted in each city, totaling approximately 54,000 per year. Weighting factors are used to increase the adult population's representativeness in each city[12] due to the low coverage of telephone lines. Details on the sampling and data collection process are provided in Vigitel publications[12,13].

This study used the following indicators evaluated in the Vigitel[12] and the respective goals proposed in the 2011-2022 Strategic Action Plan for Coping with NCDs in Brazil[1], and the WHO Global Action Plan for the Prevention and Control of NCDs[8]:

Percentage of smokers: the ratio of smokers to the total number of respondents. The individual who answered positively to the question: "Do you currently smoke?" was considered a smoker, regardless of the number of cigarettes, the frequency, and smoking habit duration. *Goal*: Reducing the prevalence of tobacco use by 30%.

Percentage of adults with obesity: the ratio of individuals with body mass index (BMI) ≥ 30 kg/m² to the total of respondents. Individuals with a BMI ≥ 30 kg/m² and self-reported height and weight were considered obese. *Goal*: Stopping the growing prevalence of obesity.

Percentage of adults consuming fruits and vegetables as recommended (indicator added in Vigitel in 2008): the ratio of individuals with recommended consumption of fruits and vegetables to the total of respondents. The consumption of one fruit or fruit juice was considered equivalent to one serving, with the maximum number of daily servings limited to three for fruit and one for juices. In the case of vegetables, the maximum number was four daily servings, which included individuals who reported consuming salads of natural greenery, cooked vegetables, and legumes for lunch and dinner. The recommendation for the consumption of fruits and greenery was considered achieved when the individual reported the consumption of these foods on at least five days a week and when the sum of the portions consumed daily totaled at least five. *Goal*: increase the consumption of fruits and vegetables by 10%.

Percentage of adults engaged in leisure physical activities (LPA) sufficiently (indicator added in Vigitel in 2009): the ratio of individuals engaging in at least 150 minutes a week of moderate-intensity physical activity or at least 75 minutes a week of vigorous-intensity physical activity to the number of individuals interviewed. *Goal*: Increasing physical activity by 10%.

Percentage of adults with alcohol abuse: the ratio of individuals with alcohol abuse to the number of individuals interviewed. Alcohol abuse was considered to be five or more doses (male) or four or more doses (female) on a single occasion, at least once in the last 30 days. A dose of alcoholic beverage is equivalent to a can of beer, a glass of wine, or a dose of cachaça, whiskey, or any other distilled alcoholic drink. *Goal*: Reducing the prevalence of alcohol abuse by at least 10%.

Choosing these indicators is justified because they are the risk (tobacco and alcohol use and obesity) and protective (consumption of fruits and vegetables and physical activity) factors common to the four main groups of NCDs (circulatory, cancer, chronic respiratory, and diabetes), where the integrated approach to these factors will act in these groups of diseases and bring benefits to other NCDs[1]. Also, they are continuous in the Vigitel questionnaire, which allowed the analysis of time-series.

The indicators were stratified by gender (female and male) and schooling years (0-8; 9-11; 12 years and more of study). The time-series were for the 2006-2019 period, except for the indicators recommended consumption of fruits and vegetables and LPA that started in 2008 and 2009, respectively, due to changes in the questionnaire used by Vigitel.

This study used the Interrupted Time-Series, a methodology that aims to verify the eventual effect of an intervention on the time trends of a measure of interest analyzed[14]. Considering the implementation of the 2011-2022 National Plan for Coping with NCDs[1], the economic crisis, and the implementation of austerity policies that resulted in changes in indicators[15,16], we calculated the time trends in the prevalence of risk and protective factors for NCDs from 2006 to 2019 (full period), 2006 to 2014 (implementation of the Plan and economic stability), and 2015 to 2019 (economic crisis and austerity).

The generalized Prais-Winsten linear regression was used to analyze time-series, adjusting the effect of first-order serial autocorrelation (AR1). A significant trend was considered when the slope of the regression (β) of the model was different from zero and the p-value less than or equal to 0.05. Thus, we observed an increased annual mean percentage variation of the indicator in the period when β was positive, with a reduction if negative and stationary when no statistically significant difference was identified. The adjusted R^2 value was used as a measure of adequacy for the model adjustment. The Durbin-Watson test was applied for the full period (2006 to 2019) to verify autocorrelation in the series.

Linear projections (y = α + βx) were prepared for each indicator, from 2011 (implementation of the national plan[1]) to 2025 (final year for the achievement of the global goals of the WHO NCD Plan[15]) in a scenario in which the goals would be achieved. Thus, we considered the following goals of the 2011-2022 Strategic Action Plan for Coping with NCDs in Brazil[1]: to reduce the prevalence of tobacco use by 30%; stop the growing prevalence of obesity; to increase the consumption of fruits and vegetables by 10%; to increase engagement in physical activity by 10%; and to reduce the prevalence alcohol abuse by at least 10%. Linear projections were made with data obtained from the different periods for all targets: 2006-2019, 2006-2014, and 2015-2019. Linear projections were also made to estimate the prevalence of the indicators up to 2025 using these periods.

We considered the post-stratification weights used in Vigitel[12,13] to analyze data, using Stata software (Stata Corp LP, College Station, Texas, US), version 13.0. Data were organized, and graphs were prepared with Microsoft® Office Excel 2016.

Vigitel data are available for public access and use, and their collection was approved by the National Human Research Ethics Committee, the Ministry of Health. The informed consent was obtained orally at the time of telephone contact with the respondents.

Outcomes

Figure 1 shows the time-series of the prevalence of risk and protection factors for NCDs, by gender, with the representation of the interruption, which hinders visualizing variations in the behavior of the indicators' prevalence starting from 2015. The trend showed a significant decline ($p < 0.05$) in the prevalence of tobacco use (A) when considering the full period. Regarding obesity (B), the recommended consumption of fruits and vegetables (C) and LPA (D) evidenced a significantly higher prevalence ($p < 0.05$). Alcohol abuse (E) recorded an increasing trend among women and remained stable among men and the total population (Figure 1).

Tables 1 and 2 show the interrupted time-series results, carried out in two periods (2006-2014 and 2015-2019), by gender and schooling, respectively. In the 2006-2014 period, the prevalence of tobacco use declined significantly ($p < 0.05$) in the total population (β=-0.64), among men (β= -0.79) and women (β = -0.50), and all schooling levels. The trends continued to decline in the second period (2015-2019), but a lower declining rate than the first period. Obesity had significant growth ($p < 0.05$) in the two periods analyzed, but the growth rate was lower between 2015 and 2019. The consumption of fruits and vegetables increased between 2006 and 2014 for both genders and the total population, and all educational levels ($p < 0.05$). On the other hand, trends in the second period were reversed, with a significant reduction in this consumption ($p < 0.05$) for the total population (β= -0.59), male (β= -0.62), female (β=-0.58), individuals with 0-8 years (β= -0.25) and 9-11 years of study (β = -0.83), remaining stable among the most educated (β= -1.16; $p = 0.08$). LPA had a significant increase in the first period for both genders and all years of study ($p < 0.05$). However, the trend leaned towards stability for the total population ($p = 0.20$) in the second period and showed a lower growth rate between men (β= 0.03) and women (β= 0.59) than the first period analyzed. Still, a stable trend was observed in the prevalence of LPA for all study levels ($p>0.05$), with reversed inclination among those aged 9-11 years

(β = -0.08; $p = 0.06$). Regarding alcohol abuse, the trends were stable for the total population, both genders, and 0-8 years of study ($p>0.05$) from 2006 to 2014. There was a small decline in the prevalence of this consumption for those with 9-11 years of schooling (β=-0.01; p=0.04) and an increase among individuals aged 12 and over (β=1.35; $p < 0.01$). The scenario changed in the 2015-2019 period, with a significant increase in this consumption among women (β=0.32), in the total population (β=0.13), and individuals with 9-11 years of study (β=0.33). On the other hand, a drop was observed ($p < 0.05$) among men (β= -0.15), those with 0-8 (β= -0.29) and 12 years or more schooling years (β= -0.06) (Tables 1 and 2).
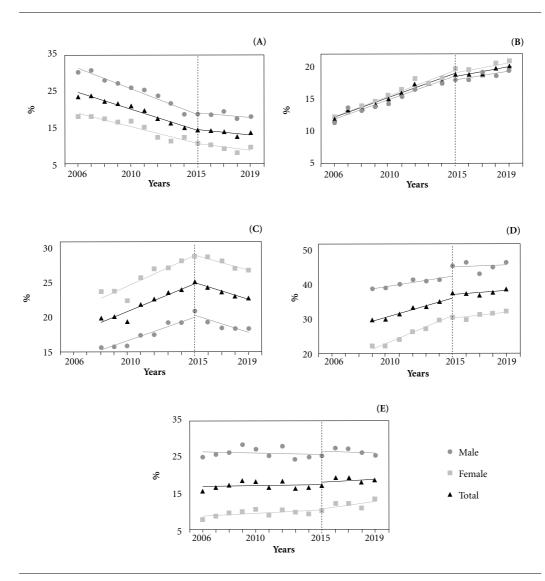
Figure 2 shows the projections of the targets for risk and protection factors for NCDs by 2025. Reducing tobacco use prevalence by 30% (A) can be achieved in all evaluated scenarios. Stopping the growth of obesity (B) would not be achieved in any scenario. The increase in fruits and vegetables consumption by 10% (C) may not be achieved, considering the 2015-2019 period. Increasing LPA by 10% (D) would be achieved in all scenarios analyzed. Reducing alcohol abuse by at least 10% (E) would not be feasible in any scenario (Figure 2).
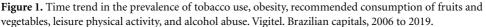
Discussion

In the 2006-2019 period, the Brazilian capitals witnessed a reduced prevalence of tobacco use, increased obesity, consumption of fruits and vegetables, and LPA, and a stable alcohol abuse trend. Overall, when analyzing the interrupted time-series, in the 2015-2019 period, the indicators showed worse performance than previous years: lower rate of reduction in the prevalence of smokers, a declining consumption of fruits and vegetables, stability in LPA, and increased alcohol abuse. The projections for 2025 showed that stopping the growth of obesity and reducing alcohol abuse would not be achieved, while the increase in the consumption of fruits and vegetables will not be achieved if we consider the 2015-2019 period. Targets would be met for the other indicators.

The improved indicators in the 2006-2014 period are related to the favorable political and economic context that allowed investments in health and higher public financing for the Unified Health System (SUS), contributing to strengthening its response capacity to face NCDs.

Figure 1. Time trend in the prevalence of tobacco use, obesity, recommended consumption of fruits and vegetables, leisure physical activity, and alcohol abuse. Vigitel. Brazilian capitals, 2006 to 2019.

(A) = Prevalence of tobacco use; (B) = Prevalence of obesity; (C) = Prevalence of recommended consumption of fruits and vegetables; (D) = Prevalence of leisure physical activity; (E) = Prevalence of alcohol abuse.

The Ministry of Health established several policies, programs, actions, and strategies, emphasizing the organization of NCD and RF[8] Surveillance and the implementation of population surveys (household, telephone, and school)[11]. The National Health Promotion Policy (PNPS) established priority actions are adequate and healthy food, bodily practices, and physical activities, and the prevention of RFs to health[17]. An expansion of PHC and Pharmaceutical Care was observed with the Popular Pharmacy Program[8]. These measures are within the context of the implementation of the 2011-2022 Strategic Actions Plan for Coping with NCDs and aligned with the global plan and the 2030 Agenda[1,8,9].

The study showed a deterioration of some indicators from 2015, which may be due to the Brazilian economic crisis and austerity, which impacted the reduction of the GDP, increased unemployment and inequalities, and directly af-

Table 1. Analysis of interrupted time-series of the prevalence of tobacco use, obesity, consumption of fruits and vegetables, leisure physical activity, and alcohol abuse, by gender. Vigitel. Brazilian capitals, 2006 to 2019.

Indicators	Gender	2006 to 2014												2015 to 2019							
		2006	2007	2008	2009	2010	2011	2012	2013	2014	β*	R²adj†	P-value‡	2015	2016	2017	2018	2019	β*	R²adj†	P-value‡
Tobacco use	Male	19.3	19.6	18.0	17.5	16.8	16.5	15.5	14.4	12.8	-0.79	0.96	< 0.001	12.8	12.7	13.2	12.1	12.3	-0.18	0.99	< 0.001
	Female	12.4	12.3	12.0	11.5	11.7	10.7	9.2	8.6	9.0	-0.50	0.92	< 0.001	8.3	8.0	7.5	6.9	7.7	-0.40	0.99	0.00
	Total	15.6	15.7	14.8	14.3	14.1	13.4	12.1	11.3	10.8	-0.64	0.97	< 0.001	10.4	10.2	10.1	9.3	9.8	-0.28	0.97	0.01
Obesity	Male	11.4	13.6	13.4	13.9	14.4	15.5	16.5	17.5	17.6	0.73	0.98	< 0.001	18.1	18.1	19.2	18.7	19.5	0.33	1.00	< 0.001
	Female	12.2	13.0	13.9	14.7	15.6	16.5	18.2	17.5	18.2	0.80	0.95	< 0.001	19.7	19.6	18.7	20.7	21.0	0.38	0.89	0.01
	Total	11.9	13.3	13.7	14.3	15.1	16.0	17.4	17.5	17.9	0.76	0.98	< 0.001	18.9	18.9	18.9	19.8	20.3	0.37	0.76	0.04
Recommended consumption of fruits and vegetables	Male	-	-	15.8	15.8	16.0	17.5	17.6	19.3	19.3	0.71	0.99	< 0.001	21	19.4	18.5	18.4	18.4	-0.62	0.80	0.03
	Female	-	-	23.7	23.9	22.5	25.8	27.2	27.3	28.2	0.91	0.86	0.001	28.9	28.7	28.2	27.2	26.8	-0.58	1.00	< 0.001
	Total	-	-	20.0	20.2	19.5	21.9	22.7	23.6	24.1	0.81	0.91	< 0.001	25.2	24.4	23.7	23.1	22.9	-0.59	0.99	< 0.001
Leisure physical activity	Male	-	-	-	39.0	39.1	40.4	41.5	41.2	41.6	0.58	0.82	0.008	45.6	46.6	43.4	45.4	46.7	0.03	0.97	0.00
	Female	-	-	-	22.1	22.4	24.0	26.5	27.4	30.0	1.65	0.99	< 0.001	30.8	29.9	31.5	31.8	32.4	0.59	1.00	< 0.001
	Total	-	-	-	29.9	30.1	31.6	33.5	33.8	35.3	1.17	1.00	< 0.001	37.6	37.6	37	38.1	39.0	0.33	0.30	0.20
Alcohol abuse	Male	24.8	25.7	26.1	28.3	27.0	25.3	27.9	24.2	24.8	-0.22	-0.01	0.36	25.3	27.3	27.1	26	25.3	-0.15	0.74	0.04
	Female	7.7	8.8	9.6	10.0	10.5	9.0	10.3	9.7	9.4	0.01	-0.16	0.92	10.2	12.1	12.2	11	13.3	0.32	0.98	< 0.001
	Total	15.6	16.6	17.2	18.4	18.1	16.5	18.4	16.4	16.5	-0.10	-0.10	0.56	17.2	19.1	19.1	17.9	18.8	0.13	0.95	0.00

*β = Angular coefficient; †R²adj = R² adjusted; ‡P-value = Significance level.

fected health services. The GDP declined in 2015 (-3.5%) and 2016 (-3.3%), with a slow recovery in the following years: 2017 (+1.3%), 2018 (+1.3%) and 2019 (+1.1%)[18]. The unemployed hiked from 6.7 in 2014 to 12.6 million in 2019, and the highest unemployment rate (12.7%) was recorded in 2017[19,20]. The Gini Index of mean monthly household income per capita decreased from 0.540 to 0.524 between 2012 and 2015. It increased to 0.537 in 2016, reaching 0.545 in 2018 and 0.543 in 2019[21]. Austerity policies were implemented, such as the approval of Constitutional Amendment 95, with reduced investments in social and health policies, science, technology, and product regulation[22,23]. Political decisions on how to respond to the economic crisis have knowingly pronounced and unintended effects on public health[24], like the higher unemployment, inflation, fiscal adjustment, and austerity are associated with lasting deteriorations in various population health indicators, such as increased adult mortality[25] and child morbimortality[26], and the negative impacts to achieve the Sustainable Development Goals (SDGs)[27].

A decreased prevalence of tobacco use has been observed. However, the reduction rate was lower than previous years between 2015 and 2019. Overall, the prevalence of tobacco use was 25.0% among men and 5.4% among women in 2015, and 11.5% of deaths (6.4 million) were attributed to tobacco use[28]. In Brazil, according to PNS, the prevalence of tobacco use in adults was 14.7%[29]. As a result, several regulatory measures sealed Brazil's commitment to reducing it, which resulted in a decreased prevalence of smokers in the country[30]. The ratification of the Framework Convention on Tobacco Control, tobacco-free environments, the definition of a minimum sale price, the prohibition of promotion, sponsorship, sale to people under 18, commercial advertising of smoke products, and the updating of guidelines for the care of smokers within the SUS are evidenced[30]. However, we observe a weakening of the government's regulatory role and the need to implement new measures to inspect the environments, points of sale, and illegal trade, and monitor activities and policies[22]. Studies carried out in Italy[31] and the U.S.[32] also identified an increased prevalence of tobacco use due to the economic crisis, justified by the supposed effect of reducing stress caused by financial problems and unemployment[31,32]. In contrast, another study also carried out in Italy between 2016 and 2017 showed a reduction in tobacco use due to lower purchasing power[33]. Thus, a crisis period can increase tobac-

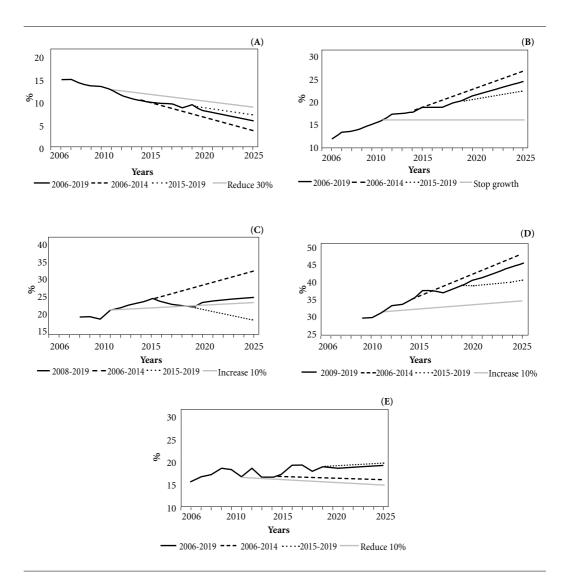co use, prevent some people from smoking, or cause others to quit smoking[33].

Obesity increased in all periods analyzed, and, according to projections, the goal of stopping its growth would not be achieved by 2025. Higher levels of obesity show inadequate diet and physical activity patterns. There were approximately 650 million obese in the world[34] in 2016. In Brazil, in 2013, the prevalence of obesity was 16.8% for men and 24.4% for women[35]. In recent decades, the Brazilian population has undergone social and economic changes that have modified their health and food consumption patterns.
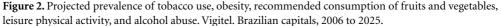
For this reason, there has been an increase in overweight and obesity in all population layers, pointing to the new scenario of problems related to food and nutrition[36]. The causes of obesity are multifactorial, with behavioral, environmental, socioeconomic, and genetic factors[37]. There is also a spread of fast food, obesogenic environments, and increased consumption of ultra-processed foods, which tend to grow in crisis times, as they have a lower price than fresh foods[38,39].

Fruits and vegetables are indispensable for a healthy eating pattern. However, low consumption is one of the leading dietary risk factors for mortality and Disability-Adjusted Life Years (DALYs)[40]. In 2017, about two million deaths worldwide were attributed to the low consumption of these foods[40]. In Brazil, according to the PNS, only 37.3% of the adult population consumed fruits and vegetables five or more times a day[41]. The positive evolution of the prevalence of fruits and vegetables consumption in the first period analyzed in this study (2006-2014) is partly due to a more favorable setting for the promotion of healthy eating in Brazil, from the actions of the Federal Government for food and nutritional security, such as the Food Acquisition Program, the National Food and Nutrition Security Plan, the National Food and Nutrition Policy, the Brazilian Population Food Guide and the books Brazilian Regional Food and In the Kitchen with Fruits, Vegetables, and Greenery[42]. Economic factors such as household income and the best price of these foods are added since Brazil had economic growth in this period[42,43]. One study observed an increase in the share of fruits and vegetables in total food purchases with lower prices or higher household income[43]. These economic factors would also explain the decreased consumption between 2015 and 2019 because of higher food prices, lower income, and higher unemployment due to the country's economic crisis[42]. Brazilians' income and food prices directly affect food ac-

Table 2. Analysis of interrupted time-series of the prevalence of smokers, obesity, consumption of fruits and vegetables, leisure physical activity, and alcohol abuse, by schooling. Vigitel. Brazilian capitals, 2006 to 2019.

Indicators	Schooling (years)	2006 to 2014											2015 to 2019						
		2006	2007	2008	2009	2010	2011	2012	2013	2014	β*	R² adj†	P-value	2015	2016	2017	2018	2019	β*	R² adj†	P-value
Tobacco use	0-8	19.1	18.9	18.9	18.1	18.1	18.2	16.3	15	14.1	-0.62	0.95	<0.001	14.4	14.3	13.2	13	13.8	-0.29	0.95	0.00
	9-11	13.8	13.5	12.0	11.9	12.2	10.7	10.0	10.3	10.3	-0.48	0.84	<0.001	9.0	9.4	9.9	8.8	9.5	-0.01	0.98	<0.001
	12 and over	10.9	12.1	10.8	10.8	10.0	9.8	9.1	7.4	6.8	-0.58	0.84	<0.001	7.2	6.9	7.4	6.2	6.7	-0.21	0.99	<0.001
Obesity	0-8	15.3	16.9	17.5	18.1	18.8	19.7	21.7	22.3	22.7	0.93	0.97	<0.001	23.6	23.5	23.3	24.5	24.2	0.26	1.00	<0.001
	9-11	9.1	10.7	10.9	12.2	13.1	14.2	15.2	15.1	17.2	0.91	1.00	<0.001	17.8	18.3	17.8	19.4	19.9	0.53	0.98	<0.001
	12 and over	8.7	9.9	10.2	10.7	11.7	13.0	14.4	14.3	12.3	0.60	0.31	0.07	14.6	14.9	16.0	15.8	17.2	0.56	0.99	0.001
Recommended consumption of fruits and vegetables	0-8	-	-	16.9	16.8	15.3	18.9	18.6	19.4	20.2	0.69	0.93	<0.001	20.1	19.7	19.5	19.3	19	-0.25	1.00	<0.001
	9-11	-	-	19.6	19.0	19.1	20.6	21.2	23.1	22.5	0.70	0.90	<0.001	23.2	23	22.1	20.9	20.2	-0.83	0.99	<0.001
	12 and over	-	-	27.1	28.5	27.4	28.9	31.4	30.1	31.9	0.76	0.99	<0.001	34.6	30.8	29.7	29.4	29.5	-1.16	0.60	0.08
Leisure physical activity	0-8	-	-	-	19.5	19.6	21.2	21.6	22	22.9	0.71	1.00	<0.001	25.4	24.5	23.3	24.6	25.8	0.09	0.49	0.12
	9-11	-	-	-	34.8	34.6	35.3	37.1	37.2	38.5	0.83	1.00	<0.001	40.1	40.4	39.7	40.4	39.5	-0.08	0.83	0.06
	12 and over	-	-	-	41.6	41.3	42.5	45.4	45.4	47.8	1.35	1.00	<0.001	49.6	47.9	47	48.1	50.0	0.10	0.67	0.06
Alcohol abuse	0-8	13.5	14	14.5	14.5	14.0	13.4	15.0	12.8	12.3	-0.14	0.29	0.08	13.2	14.2	13.8	13.0	12.4	-0.29	0.77	0.03
	9-11	17	18.6	19.2	19.8	19.6	17.5	19.4	17.5	18.4	-0.01	0.39	0.04	18.1	19.2	20.2	19.1	20	0.33	0.97	0.00
	12 and over	17.9	18.9	19.5	23.7	22.9	20.0	22.0	19.7	19.5	1.35	1.00	<0.001	20.9	24	22.8	21.2	23.1	-0.06	0.97	0.00

*β = Angular coefficient; †R²adj = R² adjusted; ‡P-value = Significance level.

Figure 2. Projected prevalence of tobacco use, obesity, recommended consumption of fruits and vegetables, leisure physical activity, and alcohol abuse. Vigitel. Brazilian capitals, 2006 to 2025.

(A) = Tobacco use; (B) = Obesity; (C) = Recommended consumption of fruits and vegetables; (D) = Leisure physical activity; (E) = Alcohol abuse.

cessibility and are determinants for healthy food consumption[44].

In the context of increased obesity and reduced consumption of fruits and vegetables, it is necessary to make further progress and investments in regulatory measures for taxing sugary drinks, subsidizing healthy foods, eliminating trans fats from industrial production, and banning children's food marketing. The WHO recommends these measures to reduce unhealthy diet[45]. Also, market regulation strategies that facilitate the production and distribution of fruits

and vegetables, such as the Food Acquisition Program and the introduction of free markets, could solve issues such as the disparity in physical and financial access to these foods[42,43]. There is also the need to establish a set of policies that aggregate all the contents that determine food insecurity in Brazil and macroeconomic policies coherent with job and income generation and are synergistic to social policies to move towards overcoming poverty[44].

Evidence on the health benefits of physical activity has been established since 1950[46]. How-

ever, in 2016, 27.5% of the adult population in the world was insufficiently active. That is, people did not meet the recommendations of at least 150 weekly minutes of LPA[47]. In Brazil, in 2013, 46.0% of the adult population was insufficiently active, and only 22.5% reached the recommendations of LPA[48]. LPA engagement increased from 2006 to 2014 and remained stationary for the total population after that, becoming a worrying scenario since physical inactivity is one of the main risk factors for NCDs, reducing life expectancy, and negatively affecting mental health and quality of life[47]. The Health Gym Program (PAS) was implemented in 2011 to promote people's health within the SUS[49]. The PAS expanded access and provided opportunities for physical activity for all, including the most vulnerable[50]. However, PAS was challenging in the current scenario. It showed difficulties in expanding the number of centers across the country and maintaining the program's activities and sustainability in the service networks of municipalities[49]. Economic crises can be associated with lifestyle changes, leading to reduced physical activity[44]. On the other hand, studies indicate that the mean working time can decrease during economic crises, increasing the time available for health promotion activities, including exercise and physical activity[51,52].

Alcohol abuse remained stable between 2006 and 2014. However, the scenario changed in 2015 with increased use in the total population and among women. Alcohol is a significant cause of premature death in Brazil and a risk factor for several diseases and health problems[53]. It was responsible for 10% of all deaths worldwide among individuals aged 15 to 49 years[54]. According to PNS data, the prevalence of alcohol abuse in Brazil was 13.7%[55]. Higher levels of alcohol abuse are observed globally, with an increasing trend among females[56]. This situation's hypothesis is related to the growth of women's autonomy due to their greater participation in the labor market and education, which allows and encourages them to consume alcoholic drinks[56]. This consumption also tends to be higher among those with higher socioeconomic status. However, alcohol abuse adverse effects are more significant among individuals with lower socioeconomic status[56]. There are also issues related to changes in consumption during periods of crisis[57]. A systematic review showed two behavioral mechanisms by which economic crises can influence alcohol use. The first mechanism indicates that the psychological distress triggered by unemployment and reduced income can increase alcoholism.

On the other hand, the second suggests that budgetary restrictions lead to lower spending on alcoholic beverages[58]. In Brazil, several initiatives have been taken to curb alcohol abuse, namely, strengthening the implementation of the price and tax increase policy, support for the escalation of inspections regarding the sale of alcoholic beverages to minors, and educational actions aimed at preventing and reducing alcohol use, and monitoring and surveillance measures[8]. It is also necessary to move forward with new regulatory measures, prohibitions or more comprehensive restrictions on alcohol advertising in the media, reducing opening hours and points of sale, and changes in Law No. 9.294/1996, which considers alcoholic beverages those with an alcohol content greater than 13° Gay-Lussac to include beers and other drinks[22,59].

Another concern is related to social determinants, such as the educational level that deteriorates the burden of disease in vulnerable populations[60]. NCDs and RFs are unevenly distributed among schooling strata. In this sense, lowly-educated individuals have a higher prevalence of NCDs, RFs, and disabilities caused by these diseases[60-62]. The low schooling level can limit access to information and healthier lifestyle habits, hindering understanding the disease's severity and adherence to treatment[63,64].

Economic crises and austerity can increase the use of services, health inequalities[15], affect the behavioral patterns and lifestyles of the population[31,51,52,58]. The current setting of the COVID-19 pandemic is also leading to changes in health indicators and a consequent deterioration of people's health standards, with increased risk factors and declining protective factors for NCDs, becoming even worse in extremely vulnerable countries, with high unemployment rates and cuts in social policies[65]. This context requires integrating intersectoral public policies, progress to reduce inequalities, strengthening health protection and promotion measures, and the continuous monitoring of NCDs, their risk factors, and the goals assumed by national and global plans.

One of the limitations of this study is the collected self-reported data, resulting in under- or overestimating the actual prevalence and generating less accurate estimates. However, the Vigitel questionnaire's validation studies indicate satisfactory results when the telephone measurements were compared with face-to-face interviews and showed promising results in the reproducibility

and validity analyses[66-68]. The fact that the Vigitel sample consists only of individuals residing in the capitals of the Brazilian states and the Federal District, living in households with landlines, represents a potential risk to the sample's representativeness. However, this issue is minimized by using data weighting factors, which seek to match the demographic features of the Vigitel sample to the characteristics of the total population, according to data from the Brazilian Institute of Geography and Statistics (IBGE) census[12,13]. Also, the analysis of the interrupted series from 2015 to 2019 is still limited. Therefore, future observations are required to verify the behavior of these indicators.

Conclusion

Analyses of interrupted time-series showed changes in the behavior of risk and protective factors for NCDs when considering the two time periods: 2006-2014 (implementation of the NCD plan and economic stability) and 2015-2019 (economic crisis and austerity). The first period evidenced a reduced prevalence of tobacco use, increased obesity, consumption of fruits and vegetables, and LPA, and a stable alcohol abuse level. However, after 2015, worse indicators were observed compared to previous years, with a lower declining rate in the prevalence of tobacco use, a decline in the consumption of fruits and vegetables, a stable level of LPA, and higher alcohol levels abuse. Projections foresee that the goals of stopping obesity and reducing alcohol use would not be achieved. For this reason, it is vital to reinforce actions to promote and encourage healthy living habits and advance regulatory measures and the sustainability of actions, programs, and policies for coping with NCDs in Brazil. The monitoring of these indicators must be continuous, especially in political and economic instability and threat to social and health rights.

Collaborations

AG Silva, RA Teixeira and DC Malta worked on the concept, outline, analysis, and interpretation of the data, in the writing and critical review of the paper, and in the approval of the version to be published. EJS Prates worked on data interpretation, drafting, critical review of the paper, and approval of the version to be published.

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Silva AG *et al.*

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